

Application Number: 10/565,279

Amendment dated: March 2, 2009

Reply to Office Action of: 2 February 2009

## **REMARKS / ARGUMENTS**

### **Remarks:**

Claim 1 has been amended. Claims 2 to 8 were left unchanged since they incorporate the content of currently amended claim 1, which is now believed to be allowable.

Claim 9 was left unchanged since it is believed to be allowable due to the arguments elaborated infra. Claims 10 to 20 were left unchanged since they incorporate the content of currently amended claim 9, which is now believed to be allowable.

Claims 10 and 11 were amended to comply with the requirements of in 35 U.S.C. 112. Claims 12-21 were amended to comply with the requirements set forth in 37 CFR 1.75 (c). Claims 21 to 23 have been added to merely split the multiple dependent claims, which were noncompliant with the requirements of 37 CFR 1.75 (c), into singly dependent form claims; no new matter has been added.

### **Arguments:**

To further distinguish the invention from the prior art, cited in the Search Report, the following arguments are provided.

Claims 1, 2 and 5 to 8 were rejected under Nickolls (5,251,626) in view of Baker (6,704,599). The technical characteristics constituting the inventive steps in claims 1 and 2 are contradistinctive relatively to Nickolls et al and Baker et al for the following reasons.

1. The invention presents an online closed-loop control system that uses a learning module (neural network is a preferred embodiment) to adapt therapeutic stimulation parameters

delivered to the patient according to the patient individual responses during his daily life activities. Nickolls and Baker do not present closed-loop control system that uses such a learning module, which is a prominently contradistinctive feature of the novelty and the inventiveness of the present invention. Nickolls uses the neural network for arrhythmia classification and for selecting a predefined therapy accordingly that will operate as an open loop therapeutic system after being selected.

2. Indeed, Nickolls is dealing with an invention aiming at classifying arrhythmias and triggering appropriate therapies, also using a neuronal network, which makes the main common point with the present invention. However, nowhere does Nickolls teach or suggest that neuronal networks shall be used for the purpose of optimizing AV and VV delays in CRT patients. Baker is one of many patent documents that are dealing with CRT in general, and there is no reason why a person normally skilled in the art would combine Nickolls with Baker for the purpose of optimizing delays in CRT patients by means of a neuronal network module. Moreover, even if one would be led to combine these two references, not all the characteristics of claim 1 would be obtained through such combination. It shall be reminded that one purpose of the “deterministic module” according to the present invention is to palliate the lacks that are inherent of the neuronal network, which is essentially non-deterministic action thereof. Therefore the wording relating to the deterministic module in claim 1 was refined so as to emphasize this particular characteristic of the “deterministic module” used in the present invention, by referring of course to what is disclosed in the description. The function of the “microprocessor” 16 in Fig. 3 of Nickolls’ neither intended nor implied for that specific purpose (please refer to description in col. 10).
3. AV and VV delays are critical parameters for resynchronization therapy delivered to congestive heart failure (CHF) patients. It is known that the hemodynamic performance like cardiac output, cardiac contractility and stroke volume depends strongly on these parameters in CRT patients and that these parameters are patient specific. The optimal AV and VV values for each patient change during patient daily life activities in

unpredicted and/or unknown way. Hence a learning module that will learn the optimal values per patient and per heart condition (rest or exercise for example) is another important aspect of the inventive step of the present invention and one of the advantages of the presented adaptive control system. Nikolls presents a system for arrhythmia control. Nikolls control system classifies and selects a pre-defined therapy and neither optimizes a hemodynamic performance online nor changes stimulation parameters online in a closed loop manner to reach optimal hemodynamic performance.

4. Due to the non-deterministic nature of neural networks, the learning module is used as a slave co-processor that is supervised by a deterministic controller that can be implemented both in software or hardware. This is an important enabling step for introducing neural networks into implanted medical devices with a safe operation of the implanted control system. Nickolls does not address the known issue of the non deterministic behavior of neural networks.
5. In neural network science, a supervised learning scheme is a learning scheme where the supervisor gives the known true output value to the neural network during training and the neural network task is to learn to associate this output with a given input. In the master-slave architecture of a deterministic and a non-deterministic modules, the supervisor or master deterministic module is responsible for putting deterministic limits to the learning module for safe operation thereof whereas the learning module is performing learning and optimization tasks inside the allowed and safe operational limits.

Claims 9, 19 and 20 were rejected over Esteller et al (2003/0158587).

6. Esteller et al describe an open loop system that use intelligent data processing unit to classify and select pre defined therapy. Since Esteller et al, in similarity to Nickolls, do not describe a closed loop system designed to optimize a physiological sensed signal and adjust online the therapy delivered in order to do, the applicant asserts that claims 9,

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19 and 20 are valid and patentable.

Claims 10 to 13 and 16 to 18 were rejected over Nickolls (5,251,626) in view of Park (5,800,467).

7. Park et al describe a method that uses an impedance measurement in a time window just after sensed R wave or pacing the ventricle and from two adjacent measurement the impedance slope ( $dz/dt$ ) is calculated which is correlated with the ventricular pressure slope ( $dp/dt$ ). Park et al do not provide a specific algorithm or control flow that use the extracted impedance slope to control the implanted pacemaker. Since Nickolls et al teaches an open loop system that uses the neural network for classification and selection of pre-defined therapy, only to use Park' impedance slope feature with Nikkols open loop system and to turn it into a closed loop online system is not obvious. As described above the present invention uses a neural network learning module in order to learn the optimal pacing intervals that maximize hemodynamic performance in an online closed loop system operation; hence claims 10-13 and 16-18 are non-obvious in light of the cited patents.

In light of the above, applicant believes that the rejections and objections presented by the Examiner in the office action mailed to applicant 2 February 2009 were overcome. Applicant therefore hopes that the Examiner will allow the application with the claims as amended to proceed to acceptance. Reconsideration and withdrawal of the rejection and issue of a notice of allowance on the pending claims is respectfully solicited.

Respectfully submitted,

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